MP0321 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appeal No. ______________

Application No.: 10/675,693

Filing Date: September 30, 2003

Appellants: Hui-Ling Lou et al.

Conf. No.: 1055

Group Art Unit: 2611

Examiner: Dac V. Ha

Title: JOINT SPACE-TIME BLOCK DECODING AND VITERBI DECODING

Attorney Docket: MP0321

APPEAL BRIEF

Mail Stop Appeal Brief-Patents
P.O. Box 1450
Alexandria, VA 22313-1450

June 26, 2009

Sir:

This brief on appeal is submitted pursuant to the Notice of Appeal filed in the U.S. Patent and Trademark Office on January 16, 2009 and in response to the Notice of Panel Decision from Pre-Appeal Brief Review mailed June 4, 2009, the Advisory Action mailed December 31, 2008, and the Final Office Action mailed October 17, 2008, rejecting Claims 1-8, 10-91 and 95-96.

TABLE OF CONTENTS

I. REAL PARTY IN INTEREST

The real party in interest is Marvell International Ltd. by virtue of assignments recorded in the Patent and Trademark Office at Reel 014590, Frame 0336 and Reel 014590, Frame 0351.

II. RELATED APPEALS AND INTERFERENCES

The Assignee, the Appellants, and the undersigned do not know of any other appeals, interferences, or judicial proceedings that would directly affect or that would be directly affected by, or have a bearing on, the Board's decision in this Appeal.

III. STATUS OF THE CLAIMS

Claims 1-8 and 10-96 are pending. Claims 1-8, 10-91, and 95-96 are rejected. Claims 92-94 are objected to, but would be allowed if rewritten in independent form.

Appellants appeal the rejection of Claims 1-8, 10-91 and 95-96 and the objection of Claims 92-94.

IV. STATUS OF THE AMENDMENTS

The claims have not been amended subsequent to the Final Office Action, and there are no un-entered amendments.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

Independent Claim 1 recites a space-time block decoder for a wireless communications system (e.g., space-time block decoder 34 of FIG. 3, and paragraph [0029]). A demodulator generates a demodulated symbol sequence by derotating a signal constellation of a received symbol sequence (e.g., demodulator 36 of FIG. 3, paragraphs [0029], [0030] and [0035], and page 9, line 21-page 10, line 8). A dimension demultiplexer communicates with the demodulator and generates in-phase and quadrature components of the demodulated symbol sequence that are encoded based on a space time block code and an outer code (e.g., demultiplexer 38 of FIG. 3, paragraphs [0005], [0006], [0028]-[0030] and [0035], page 2, line 6-page 3, line 13, page 9, line 18-page 10, line 5 and page 10, lines 8-14). A branch metric computation module communicates with the dimension demultiplexer and generates branch metrics based on the in-phase and quadrature components (e.g., branch metric computation module 40 of FIG. 3, branch metrics $BM_{l,l}$, in-phase and quadrature components $\Re\{z_l\},\Im\{z_l\}$, paragraphs [0005]-[0007], [0029], [0030] and [0035], page 2, line 6-page 4, line 5, page 9, line 21-page 10, line 2, page 10, lines 12-19, and page 13, lines 4-16).

Independent Claim 17 recites a receiver for a wireless communications system that includes at least one receiving antenna that receives a received symbol sequence (e.g., paragraphs [0003] and [0007], page 1, lines 14-23, and page 3, lines 14-17). A space-time block decoder communicates with the at least one receiving antenna (e.g., space-time block decoder 34 of FIG. 3, and paragraph [0029]). The space-time block decoder generates a user data sequence based on the received symbol sequence (e.g., user data sequence $\hat{d}$ and received symbol

sequence r, paragraphs [0028]-[0031], and page 9, line 10-page 10, line 22). The space-time block decoder includes a branch metric computation module that generates branch metrics based on separated in-phase and quadrature components of a demodulated symbol sequence (e.g., branch metric computation module 40 of FIG. 3, branch metrics $BM_{i,l}$, in-phase and quadrature components $\Re\{z_i\},\Im\{z_i\}$, paragraphs [0005]-[0007], [0029], [0030] and [0035], page 2, line 6-page 4, line 5, page 9, line 21-page 10, line 2, page 10, lines 12-19, and page 13, lines 4-16). The demodulated symbol sequence is based on the received symbol sequence (e.g., demodulated symbol sequence z and received symbol sequence r). The separated in-phase and quadrature components are encoded based on a space time block code and an outer code (e.g., paragraphs [0005], [0006], and [0028], page 2, line 6-page 3, line 13, and page 9, lines 18-20).

Independent Claim 35 recites a space-time block decoder for a wireless communications system (e.g., space-time block decoder 34 of FIG. 3, and paragraph [0029]). The space-time block decoder includes demodulating means for generating a demodulated symbol sequence by derotating a signal constellation of a symbol sequence (e.g., demodulator 36 of FIG. 3, demodulated symbol sequence z, paragraphs [0029], [0030] and [0035], and page 9, line 21-page 10, line 8). Dimension demultiplexing means communicates with the demodulating means for generating in-phase and quadrature components of the demodulated symbol sequence (e.g., demultiplexer 38 of FIG. 3, in-phase and quadrature components $\Re\{z_i\},\Im\{z_i\}$, paragraphs [0005], [0006], [0028]-[0030] and [0035], page 2, line 6-page 3, line 13, page 9, line 18-page 10, line 5 and page 10, lines 8-14). The in-phase and quadrature components are encoded based on a space time block

code and an outer code (e.g., paragraphs [0005], [0006], and [0028], page 2, line 6-page 3, line 13, and page 9, lines 18-20). Branch metric computing means communicates with the dimension demultiplexing means for generating branch metrics based on the in-phase and quadrature components (e.g., branch metric computation module 40 of FIG. 3, branch metrics $BM_{i,l}$, in-phase and quadrature components $\Re\{z_i\},\Im\{z_i\}$, paragraphs [0005]-[0007], [0029], [0030] and [0035], page 2, line 6-page 4, line 5, page 9, line 21-page 10, line 2, page 10, lines 12-19, and page 13, lines 4-16).

Independent Claim 47 recites a receiver for a wireless communications system (e.g., paragraphs [0003] and [0007], page 1, lines 14-23, and page 3, lines 14-17). The receiver includes receiving means for receiving a symbol sequence (e.g., paragraphs [0003] and [0007], page 1, lines 14-23, and page 3, lines 14-17). Space-time block decoding means communicates with the receiving means for generating user data based on the symbol sequence (e.g., space-time block decoder 34 of FIG. 3, user data sequence $\hat{d}$ and received symbol sequence r, paragraphs [0028]-[0031], and page 9, line 10-page 10, line 22). The space-time block decoding means includes branch metric computing means for generating branch metrics based on separated in-phase and quadrature components of a demodulated symbol sequence (e.g., branch metric computation module 40 of FIG. 3, branch metrics $BM_{i,l}$, in-phase and quadrature components $\Re\{z_i\},\Im\{z_i\}$, paragraphs [0005]-[0007], [0029], [0030] and [0035], page 2, line 6-page 4, line 5, page 9, line 21-page 10, line 2, page 10, lines 12-19, and page 13, lines 4-16). The demodulated symbol sequence is based on the symbol sequence (e.g., demodulated symbol sequence z and received symbol sequence r). The separated in-phase and

quadrature components are encoded based on a space time block code and an outer code (e.g., paragraphs [0005], [0006], and [0028], page 2, line 6-page 3, line 13, and page 9, lines 18-20).

Independent Claim 61 recites a method for operating a space-time block decoder in a wireless communications system (e.g., space-time block decoder 34 of FIG. 3, and paragraph [0029]). The space-time block decoder generates a demodulated symbol sequence by derotating a signal constellation of a received symbol sequence (e.g., demodulator 36 of FIG. 3, demodulated symbol sequence z, paragraphs [0029], [0030] and [0035], and page 9, line 21-page 10, line 8). In-phase and quadrature components of the demodulated symbol sequence that are encoded based on a space time block code and an outer code are separated (e.g., demultiplexer 38 of FIG. 3, paragraphs [0005], [0006], [0028]-[0030] and [0035], page 2, line 6-page 3, line 13, page 9, line 18-page 10, line 5 and page 10, lines 8-14). Branch metrics are generated based on the in-phase and quadrature components (e.g., branch metric computation module 40 of FIG. 3, branch metrics $BM_{l,l}$, in-phase and quadrature components $\Re\{z_l\},\Im\{z_l\}$, paragraphs [0005]-[0007], [0029], [0030] and [0035], page 2, line 6-page 4, line 5, page 9, line 21-page 10, line 2, page 10, lines 12-19, and page 13, lines 4-16).

Independent Claim 73 recites a method of operating a receiver for a wireless communications system is provided (e.g., paragraphs [0003] and [0007], page 1, lines 14-23, and page 3, lines 14-17). The method includes receiving a symbol sequence (e.g., user data sequence $\hat{d}$ and received symbol sequence r, paragraphs [0028]-[0031], and page 9, line 10-page 10, line 22). User data is generated based on the symbol sequence by

generating branch metrics based on separated in-phase and quadrature components of a demodulated symbol sequence (e.g., branch metric computation module 40 of FIG. 3, branch metrics $BM_{i,l}$, in-phase and quadrature components $\Re\{z_i\},\Im\{z_i\}$, demodulated symbol sequence z, paragraphs [0005]-[0007], [0029], [0030] and [0035], page 2, line 6-page 4, line 5, page 9, line 21-page 10, line 2, page 10, lines 12-19, and page 13, lines 4-16). The demodulated symbol sequence is based on the received symbol sequence (e.g., demodulated symbol sequence z and received symbol sequence r). The separated in-phase and quadrature components are encoded based on a space time block code and an outer code (e.g., paragraphs [0005], [0006], and [0028], page 2, line 6-page 3, line 13, and page 9, lines 18-20).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Appellants seek the Board's review of:

(a) whether Claims 1-3, 10-13, 17-21, 26-31, 35-37, 40-43, 47, 48-52, 54-57, 61-63, 66-69, 74-76, 79-82, 89-91 and 96 are unpatentable under 35 U.S.C. § 103(a) over U.S. Pub. No. 2002/0196842 ("Onggosanusi") in view of U.S. Patent No. 5,757,834 ("Fang");

(b) whether Claims 4-8, 22-25, 38, 39, 53, 64, 65, 77 and 78 are unpatentable under 35 U.S.C. § 103(a) over Onggosanusi in view of Fang and in further view of U.S. Patent No. 6,680,986 ("Hemmati"); and

(c) whether Claims 14-16, 32-34, 44-46, 58, 60, 70-72 and 83-85 are unpatentable under 35 U.S.C. § 103(a) over Onggosanusi in view of Fang and in further view of U.S. Patent No. 6,977,972 ("Kandala").

VII. ARGUMENTS

A. Rejection under 35 U.S.C. § 103(a) over Onggosanusi in view of Fang

1. Claims 1-3, 10-13, 17-21, 26-31, 35-37, 40-43, 47, 48-52, 54-57, 61-63, 66-69, 74-76, 79-82, 89-91 and 96

Claim 1 recites a dimension demultiplexer that generates in-phase and quadrature components of a demodulated symbol sequence that are encoded based on a space time block (STB) code and an outer code. A branch metric computation module generates branch metrics based on the in-phase and quadrature components.

(a) Onggosanusi fails to disclose the dimension demultiplexer and the branch metric computation module recited in Independent Claim 1

The Examiner admits that Onggosanusi fails to disclose the claimed dimension demultiplexer and branch metric computation module (see paragraph 5, lines 8-15 of the Final Office Action mailed October 17, 2008, hereinafter "the Office Action").

Appellants submit that Onggosanusi also does not disclose: a demultiplexer; a device that generates in-phase and quadrature components of a demodulated symbol sequence; and/or a device that generates components of a demodulated symbol sequence that are **encoded** based on a STB code and an outer code.

Onggosanusi discloses a receiver 104 with decoders 110_1, 110_2 and a channel decoder 40''. The decoders 110_1, 110_2 are used for STB decoding. The decoder 40'' is used for outer decoding. A joint interference cancellation and detector device 88', a parallel/serial device 34'', a demodulator 36'', and a deinterleaver 38'' are connected between the decoders 110_1, 110_2 and the channel decoder 40''. See FIG. 4 of Onggosanusi. The

receiver does not include a demultiplexer or a device that generates in-phase and quadrature components.

The signals received by the devices 88', 34'' and by the demodulator 36'', the deinterleaver 38'' and/or the channel decoder 40'' of Onggosanusi are not STB encoded. Since the decoders 110_1, 110_2 decode a STB code, the output of the decoders 110_1, 110_2 is not STB encoded. The signal generated by, for example, the demodulator 36'' is not a demodulated symbol sequence that is encoded based on a STB code. Therefore, Onggosanusi does not disclose a demodulator that generates a symbol sequence that is encoded based on a STB code.

The Examiner alleges that Onggosanusi discloses a demodulated sequence that is generated based on a STB code. Claim 1 recites a demodulator that generates a demodulated symbol sequence that is **encoded** based on a STB code. The demodulated sequence generated in Onggosanusi (output of demodulator 36'') is not encoded based on a STB code, but rather based on an outer code. In Onggosanusi, a received signal is STB decoded prior to demodulation by the demodulator 36''. For example, in FIG. 4 of Onggosanusi, the signal received by the demodulator 36'' is based on outputs of decoders 110_1, 110_2, which decode a STB encoded signal to generate a STB decoded signal. Thus, the outputs of the decoders 110_1, 110_2 are not STB encoded.

For at least the above reasons, Onggosanusi does not disclose any of the features of the claimed dimension demultiplexer. Onggosanusi also does not disclose the branch metric computation module because the features of the claimed branch metric computation module depend on the features of the dimension demultiplexer. The branch metric computation module

generates the branch metrics based on the I and Q components from the dimension demultiplexer.

(b) Onggosanusi and Fang fail to disclose the dimension demultiplexer and the branch metric computation module recited in Claim 1

The Examiner alleges that Fang discloses a demodulator that generates I and Q components, the dimension demultiplexer and the branch metric computation module of Claim 1. The Examiner further alleges that the demodulator 36'' and the channel decoder 40'' of Onggosanusi may be replaced with the demodulator 10 and the Viterbi decoder 15 of Fang. See page 7, lines 11-20 of the Final Office Action and page 3, lines 7-9, of the Advisory Action. Even if this replacement is proper, it does not make up for the deficiencies of Onggosanusi set forth above.

Fang discloses a receiver with a demodulator 10 and a Viterbi decoder 15 that includes a branch metric calculation device 16. The receiver of Fang receives a signal that is outer encoded, not STB encoded. The demodulator 10 generates in-phase and quadrature (I and Q) components based on the received outer encoded signal, not based on an encoded STB symbol sequence.

The disclosure by Fang of generating I and Q components of an outer encoded symbol sequence is irrelevant. The signal received by the demodulator 36'' of Onggosanusi is not STB encoded. The signal received by the demodulator 36'' is based on the output of the decoders 110_1, 110_2. Since the decoders 110_1, 110_2 decode a STB code, the output of the decoders 110_1, 110_2 is not STB encoded. As such, should the demodulator 36'' of Onggosanusi be replaced with the demodulator 10 of Fang, the output of the demodulator 10 would still not be STB encoded.

Also, Fang only discloses outer decoding, not inner decoding. Thus, the replacement of the demodulator 36'' of Onggosanusi with the demodulator 10 of Fang would not generate STB encoded I and Q components, as claimed.

Therefore, Onggosanusi and Fang do not disclose several features of Claim 1.

Relevance of I and Q Component Disclosure of Fang

On page 3, lines 1-5, of the Advisory Action, the Examiner alleges that the I and Q component disclosure of Fang is relevant, since Onggosanusi uses phase-shift keying (PSK) as a modulation scheme. PSK may be used by an outer encoder when encoding a symbol sequence. Outer encoding is performed independent of STB encoding. Likewise, outer decoding is typically performed independent of STB decoding, as shown and described in Onggosanusi.

Note that joint decoding, which may include the generation of I and Q components of a STB encoded and outer encoded symbol sequence, is disclosed in the application and not in the relied upon art. Joint decoding refers to the conversion of an inner and outer encoded symbol sequence to an original sequence during the same time period. This reverses the effects of both the inner and outer encoding processes. Simply put and with respect to STB and outer encoding, joint decoding refers to performing STB decoding while performing outer decoding.

Thus, the disclosure by Fang of I and Q component generation with respect to outer decoding is not relevant.

Claim Limitations Relative to Joint Decoding

Thus, regardless of whether the combination of Fang and Onggosanusi suggests the generation of I and Q components by a demodulator for outer decoding, the combination of Fang and

Onggosanusi does not suggest the generation of I and Q components by a demultiplexer for STB decoding. The combination of Fang and Onggosanusi also does not suggest the generation of I and Q components for both STB decoding and outer decoding or of a symbol sequence that is both STB encoded and outer encoded.

As disclosed in the application, the limitations of Claim 1 are beginning steps of a joint decoding process. In one aspect, joint decoding reverses the effects of a first encoding process that is based on an inner code <u>while</u> reversing the effects of a second encoding process that is based on an outer code.

Claim 1 explicitly states that I and Q components are encoded based on a STB code and an outer code. The separation of a demodulated symbol sequence (jointly encoded signal) into STB encoded I and Q components allows a branch metric computation module to generate one-dimensional branch metrics. See, for example, paragraphs [0029], [0030], [0033], [0035], and [0036] of the application. The one-dimensional branch metrics are based respectively on each of the I and Q components. A Viterbi decoder may than determine a most likely received sequence based on the one-dimensional branch metrics. The one-dimensional branch metrics are used instead of multi-dimensional branch metrics, which are common when performing separate decoding of STB encoded and outer encoded signals. See paragraphs [0007]-[0009] of the application.

The use of one-dimensioned branch metrics reduces the computation complexity involved in the decoding process performed by, for example, a Viterbi decoder. Onggosanusi and Fang do not disclose a joint decoding process and thus do not disclose the beginning steps of a joint decoding process, as recited in Claim 1.

Generation of I and Q Components in a STB Receiving Path

Here, Onggosanusi does not disclose generation of I and Q components. Fang discloses the generation of I and Q components after demodulation of an outer encoded signal. The combination of Onggosanusi and Fang does not disclose the generation of I and Q components of a STB encoded signal. Thus, the features of Claim 1 would not have been obvious in view of Onggosanusi and Fang.

On page 3 of the Advisory Action, the Examiner appears to take Official Notice in stating that the technique of Fang could have been used to produce I and Q components anywhere in a receiving chain. According to MPEP § 2144.03, Official Notice unsupported by documentary evidence should only be taken by the Examiner where the facts asserted to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known. See *In re Ahlert*, 424 F.2d 1088, 1091, 165 USPQ 418, 420 (CCPA 1970). Also, when the Appellants challenge a factual assertion, as not properly officially noticed or not properly based upon common knowledge, the Examiner must support the finding with adequate evidence. See 37 CFR 1.104(c)(2). Appellants challenge the Official Notice taken by the Examiner.

Disclosure of Joint Decoding in the Application

On page 5 of the Advisory Action, the Examiner alleges that there is no clear explanation of what is meant by joint decoding. Appellants disagree. In paragraphs [0007] and [0008] of the application, separate decoding of space time block encoded and outer encoded signals is described. In paragraph [0028], an example demodulated symbol sequence after passing through a channel is shown as expression A. Joint decoding is mentioned in paragraph [0028] and then is described at least in

paragraphs [0030]-[0034]. Paragraph [0030] describes the generation of I and Q components for symbols that are space time block encoded and outer encoded.

Paragraph [0033] of the application: provides example one-dimensional branch metrics; describes how the one-dimensional branch metrics are determined based on I and Q components; and describes the use of a Viterbi decoder to determine a most likely sequence based on the one-dimensional branch metrics. The joint decoding process includes the generation of the I and Q components, the generation of the one-dimensional branch metrics, and the determining of decoded symbols based on the one-dimensional branch metrics. Thus, an adequate description is provided in the specification of the application for joint decoding.

Recitation of Joint Decoding in Claim 1

On page 5 of the Advisory Action, the Examiner also appears to suggest that added recitation in Claim 1 of joint decoding in a single step may distinguish over the relied upon art. Appellants submit that although such recitation would further distinguish over the relied upon references, such recitation is not necessary, since the relied upon references fail to satisfy the All Elements Rule.

Appellants understand that the application describes in detail decoding of a STB code while decoding of an outer code. However, additional recitation of the specifics of this process are not needed in the claims, as the claims already include features of this process, which are not disclosed in the relied upon references.

(c) Onggosanusi and Fang fail to disclose a branch metric computation module as recited in Independent Claim 17

Claim 17 recites a branch metric computation module that generates branch metrics based on separated in-phase and quadrature components of a demodulated symbol sequence. The demodulated symbol sequence is based on a received symbol sequence. The separated in-phase and quadrature components are encoded based on a STB code and an outer code.

Appellants have shown that Onggosanusi and Fang at least fail to show teach or suggest a branch metric computation module that generates branch metrics based on separated I and Q components that are encoded based on a STB code and an outer code. Thus, the Examiner has failed to show support in the relied upon references for each and every feature of Claim 17.

The Examiner admits that Onggosanusi does not disclose a branch metric computation module. The Examiner alleges that Fang discloses a branch metric computation module. As best understood by Appellants, Fang discloses a branch metric computation module 16 that generates branch metrics based on I and Q signals, which are encoded based on an outer code and not based on a STB code. Thus, Onggosanusi and Fang fail to disclose each and every limitation of Claim 17.

The Examiner also alleges that since a demodulated sequence is based on a received signal, the components of the demodulated sequence (after being quadrature split) provide a signal that is based on a STB code and an outer code. The received signal is STB encoded and outer encoded. This reasoning appears to be illogical and/or irrelevant.

The Examiner appears to allege that the I and Q components of a demodulated sequence are based on a STB code and an outer code when a received signal that is demodulated is STB encoded

and outer encoded. Claim 17 recites that separated in-phase and quadrature components **are encoded based on a STB code and an outer code**. Claim 17 does not recite that the separated in-phase and quadrature components **are generated based on a STB and outer encoded signal**.

In Onggosanusi, a received signal is STB decoded by the decoder 110_1, 110_2 before being passed to the demodulator 36'' and the outer decoder 40''. The replacement of the demodulator 36'' and the decoder 40'' with the demodulator 10 and the decoder 15 of Fang does not change the output of the decoders 110_1, 110_2 of Onggosanusi. Thus, the output of the demodulator 10 of Fang as combined with Onggosanusi provides I and Q components that are not STB encoded, but rather are generated based on a demodulator received signal that is STB decoded. Also, the branch metric computation of Fang is not based on STB encoded I and Q components. In contrast, the claimed branch metric computation module generates branch metrics based on STB encoded I and Q components.

(d) The Examiner has failed to establish a prima facie case of obviousness

To establish a *prima facie* case of obviousness, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *See, e.g.*, *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Onggosanusi and Fang clearly fail to disclose the dimension demultiplexer and branch metric computation modules of Claims 1 and 17. Consequently, the combination of Onggosanusi and Fang cannot render Claims 1 and 17 obvious.

In view of the foregoing, Appellants respectfully submit that Claim 1 and 17 are in condition for allowance for at least the above reasons.

(e) Remaining Claims

Independent Claims 35, 47, 61 and 73 include similar limitations and are therefore allowable for at least similar reasons as Claims 1 and 17.

Dependent Claims 2-8, 10-16, 18-34, 36-46, 48-60, 62-72 and 74-96 ultimately depend from Claims 1, 17, 35, 47, 61 and 73 and are therefore allowable for at least similar reasons.

Appellants' position with respect to Claims 2-8, 10-16, 18-34, 36-46, 48-60, 62-72 and 74-96 should not be understood as implying that no other reasons for the patentability of Claims 2-8, 10-16, 18-34, 36-46, 48-60, 62-72 and 74-96 exist. Appellants reserve the right to address these other reasons at a later date if needed.

B. Rejection under 35 U.S.C. § 103(a) over Onggosanusi in view of Fang and in further view of Hemmati

1. Claims 4-8, 22-25, 38, 39, 53, 64, 65, 77 and 78

Hemmati does not remedy the deficiencies of Onggosanusi and Fang with respect to Claims 1, 17, 35, 47, 61 and 73, from which Claims 4-8, 22-25, 38, 39, 53, 64, 65, 77 and 78 depend. Therefore, Claims 4-8, 22-25, 38, 39, 53, 64, 65, 77 and 78 are in condition for allowance for at least similar reasons as Claims 1, 17, 35, 47, 61 and 73.

Appellants' position with respect to Claims 4-8, 22-25, 38, 39, 53, 64, 65, 77 and 78 should not be understood as implying that no other reasons for the patentability of Claims 4-8, 22-

25, 38, 39, 53, 64, 65, 77 and 78 exist. Appellants reserve the right to address these other reasons at a later date if needed.

C. Rejection under 35 U.S.C. § 103(a) over Onggosanusi in view of Fang and in further view of Kandala

1. Claims 14-16, 32-34, 44-46, 58, 60, 70-72 and 83-85

Kandala does not remedy the deficiencies of Onggosanusi and Fang with respect to Claims 1, 17, 35, 47, 61 and 73, from which Claims 4-8, 22-25, 38, 39, 53, 64, 65, 77 and 78 depend. Therefore, Claims 4-8, 22-25, 38, 39, 53, 64, 65, 77 and 78 are in condition for allowance for at least similar reasons as Claims 1, 17, 35, 47, 61 and 73.

Appellants' position with respect to Claims 4-8, 22-25, 38, 39, 53, 64, 65, 77 and 78 should not be understood as implying that no other reasons for the patentability of Claims 4-8, 22-25, 38, 39, 53, 64, 65, 77 and 78 exist. Appellants reserve the right to address these other reasons at a later date if needed.

CONCLUSION

Appellants respectfully request the Board to reverse the Examiner's rejection of the claims on appeal.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

HARNESS, DICKEY, & PIERCE, P.L.C.

By: Michael D. Wiggins
Michael D. Wiggins
Reg. No. 34,754

Jeffrey J. Chapp
Reg. No. 50,579

Please address all correspondence to:

Harness, Dickey & Pierce, P.L.C.
5445 Corporate Drive
Suite 200
Troy, MI 48098
Customer No. 26703
Tel. No. (248) 641-1600
Fax. No. (248) 641-0270

MDW/JJC/ma

VIII. CLAIMS APPENDIX

This is a complete and current listing of the claims.

1. (Previously Presented) A space-time block decoder for a wireless communications system, comprising:

a demodulator that generates a demodulated symbol sequence by derotating a signal constellation of a received symbol sequence;

a dimension demultiplexer that communicates with said demodulator and that generates in-phase and quadrature components of said demodulated symbol sequence that are encoded based on a space time block code and an outer code; and

a branch metric computation module that communicates with said dimension demultiplexer and that generates branch metrics based on said in-phase and quadrature components.

2. (Original) The space-time block decoder of Claim 1 further comprising:

a Viterbi decoder that communicates with said branch metric computation module and that generates a user data sequence based on said branch metrics.

3. (Original) The space-time block decoder of Claim 1 wherein said demodulator derotates said signal constellation by multiplying said received symbol sequence and a conjugate of a channel response of said wireless communications system.

4. (Original) The space-time block decoder of Claim 2 wherein said Viterbi decoder generates said user data sequence by determining a minimum of a plurality of path metrics that comprise accumulations of said branch metrics.

5. (Original) The space-time block decoder of Claim 4 wherein said plurality of path metrics includes possible state transitions that identify a successive symbol in said received symbol sequence.

6. (Original) The space-time block decoder of Claim 1 wherein a receiver that communicates with said space-time block decoder includes one receive antenna and a transmitter that communicates with said receiver includes two transmit antennae.

7. (Original) The space-time block decoder of Claim 6 wherein said receive antenna receives two symbols during first and second consecutive symbol periods.

8. (Original) The space-time block decoder of Claim 1 wherein a receiver that communicates with said space-time block decoder includes at least two receive antennae and a transmitter that communicates with said receiver includes two transmit antennae.

9. (Cancelled).

10. (Original) The space-time block decoder of Claim 1 wherein at least one symbol in said received symbol sequence is encoded with an orthogonal space-time code.

11. (Original) The space-time block decoder of Claim 1 wherein said signal constellation is generated by one of a bi-phase shift keying (BPSK) code, a quadrature phase shift keying (QPSK) code, a 16-quadrature amplitude modulation (QAM) code, a 64-QAM code, and a 256-QAM code.

12. (Original) The space-time block decoder of Claim 1 wherein said space-time block decoder is implemented in a wireless metropolitan area network (WMAN).

13. (Previously Presented) The space-time block decoder of Claim 1 wherein said space-time block decoder is implemented in a wireless local area network (WLAN).

14. (Original) The space-time block decoder of Claim 1 wherein said in-phase and quadrature components comprise Gray coded data that is bit-interleaved.

15. (Original) The space-time block decoder of Claim 14 wherein said branch metric computation module implements bit-by-bit piecewise linear approximation to generate said branch metrics.

16. (Original) The space-time block decoder of Claim 15 further comprising:

a deinterleaver that communicates with said branch metric computation module and that generates deinterleaved metrics based on said branch metrics.

17. (Previously Presented) A receiver for a wireless communications system, comprising:

at least one receiving antenna that receives a received symbol sequence; and

a space-time block decoder that communicates with said at least one receiving antenna, that generates a user data sequence based on said received symbol sequence, and that includes:

a branch metric computation module that generates branch metrics based on separated in-phase and quadrature components of a demodulated symbol sequence,

wherein said demodulated symbol sequence is based on said received symbol sequence, and

wherein said separated in-phase and quadrature components are encoded based on a space time block code and an outer code.

18. (Original) The receiver of Claim 17 wherein said space-time block decoder includes a demodulator that communicates with said at least one receiving antenna and that generates said demodulated symbol sequence by derotating a signal constellation of said received symbol sequence.

19. (Original) The receiver of Claim 18 wherein said space-time block decoder includes a dimension demultiplexer that communicates with said demodulator and said branch metric computation module and that generates said in-phase and quadrature components.

20. (Original) The receiver of Claim 18 wherein said demodulator derotates said signal constellation by multiplying said received symbol sequence and a conjugate of a channel response of said wireless communications system.

21. (Original) The receiver of Claim 17 wherein said space-time block decoder includes a Viterbi decoder that communicates with said branch metric computation module and that generates said user data sequence based on said branch metrics.

22. (Original) The receiver of Claim 21 wherein said Viterbi decoder generates said user data sequence by determining a minimum of a plurality of path metrics that comprise accumulations of said branch metrics.

23. (Original) The receiver of Claim 22 wherein said plurality of path metrics comprises possible state transitions that identify a successive symbol in said received symbol sequence.

24. (Original) The receiver of Claim 17 wherein said receiver includes one receive antenna and wherein a transmitter that communicates with said receiver includes two transmit antennae.

25. (Original) The receiver of Claim 24 wherein said receive antenna receives two symbols during first and second consecutive symbol periods.

26. (Original) The receiver of Claim 17 wherein a transmitter that communicates with said receiver includes two transmit antennae.

27. (Original) The receiver of Claim 17 wherein a transmitter that communicates with said receiver includes at least two transmit antennae.

28. (Original) The receiver of Claim 17 wherein at least one symbol in said received symbol sequence is encoded with an orthogonal space-time code.

29. (Original) The receiver of Claim 18 wherein said signal constellation is generated by one of a bi-phase shift keying (BPSK) code, a quadrature phase shift keying (QPSK) code, a 16-quadrature amplitude modulation (QAM) code, a 64-QAM code, and a 256-QAM code.

30. (Original) The receiver of Claim 17 wherein said receiver is implemented in a wireless metropolitan area network (WMAN).

31. (Previously Presented) The receiver of Claim 17 wherein said receiver is implemented in a wireless local area network (WLAN).

32. (Original) The receiver of Claim 17 wherein said in-phase and quadrature components comprise Gray coded data that is bit-interleaved.

33. (Original) The receiver of Claim 32 wherein said branch metric computation module implements bit-by-bit piecewise linear approximation to generate said branch metrics.

34. (Original) The receiver of Claim 33 further comprising a deinterleaver that communicates with said branch metric computation module and that generates deinterleaved metrics based on said branch metrics.

35. (Previously Presented) A space-time block decoder for a wireless communications system, comprising:

demodulating means for generating a demodulated symbol sequence by derotating a signal constellation of a symbol sequence;

dimension demultiplexing means that communicates with said demodulating means for generating in-phase and quadrature components of said demodulated symbol sequence that are encoded based on a space time block code and an outer code; and

branch metric computing means that communicates with said dimension demultiplexing means for generating branch metrics based on said in-phase and quadrature components.

36. (Original) The space-time block decoder of Claim 35 further comprising:

Viterbi decoding means that communicates with said branch metric computing means for generating user data based on said branch metrics.

37. (Original) The space-time block decoder of Claim 35 wherein said demodulating means derotates said signal constellation by multiplying said symbol sequence and a conjugate of a channel response of said wireless communications system.

38. (Original) The space-time block decoder of Claim 36 wherein said Viterbi decoding means generates said user data by determining a minimum of a plurality of path metrics that comprise accumulations of said branch metrics.

39. (Original) The space-time block decoder of Claim 38 wherein said plurality of path metrics includes possible state transitions that identify a successive symbol in said symbol sequence.

40. (Original) The space-time block decoder of Claim 35 wherein at least one symbol in said symbol sequence is encoded with an orthogonal space-time code.

41. (Original) The space-time block decoder of Claim 35 wherein said signal constellation is generated by one of a bi-phase shift keying (BPSK) code, a quadrature phase shift keying (QPSK) code, a 16-quadrature amplitude modulation (QAM) code, a 64-QAM code, and a 256-QAM code.

42. (Original) The space-time block decoder of Claim 35 wherein said space-time block decoder is implemented in a wireless metropolitan area network (WMAN).

43. (Previously Presented) The space-time block decoder of Claim 35 wherein said space-time block decoder is implemented in a wireless local area network (WLAN).

44. (Original) The space-time block decoder of Claim 35 wherein said in-phase and quadrature components comprise Gray coded data that is bit-interleaved.

45. (Original) The space-time block decoder of Claim 44 wherein said branch metric computing means implements bit-by-bit piecewise linear approximation to generate said branch metrics.

46. (Original) The space-time block decoder of Claim 45 further comprising:

deinterleaving means that communicates with said branch metric computing means for generating deinterleaved metrics based on said branch metrics.

47. (Previously Presented) A receiver for a wireless communications system, comprising:

receiving means for receiving a symbol sequence; and

space-time block decoding means that communicates with said receiving means for generating user data based on said symbol sequence, and that includes:

branch metric computing means for generating branch metrics based on separated in-phase and quadrature components of a demodulated symbol sequence,

wherein said demodulated symbol sequence is based on said symbol sequence, and

wherein said separated in-phase and quadrature components are encoded based on a space time block code and an outer code.

48. (Original) The receiver of Claim 47 wherein said space-time block decoding means includes demodulating means that communicates with said receiving means for generating said demodulated symbol sequence by derotating a signal constellation of said symbol sequence.

49. (Original) The receiver of Claim 48 wherein said space-time block decoding means includes dimension demultiplexing means that communicates with said demodulating means and said branch metric computing means for generating said in-phase and quadrature components.

50. (Original) The receiver of Claim 48 wherein said demodulating means derotates said signal constellation by multiplying said symbol sequence and a conjugate of a channel response of said wireless communications system.

51. (Original) The receiver of Claim 47 wherein said space-time block decoding means includes Viterbi decoding means that communicates with said branch metric computing means for generating said user data based on said branch metrics.

52. (Original) The receiver of Claim 51 wherein said Viterbi decoding means generates said user data by determining a minimum of a plurality of path metrics that comprise accumulations of said branch metrics.

53. (Original) The receiver of Claim 52 wherein said plurality of path metrics comprises possible state transitions that identify a successive symbol in said symbol sequence.

54. (Original) The receiver of Claim 47 wherein at least one symbol in said symbol sequence is encoded with an orthogonal space-time code.

55. (Original) The receiver of Claim 48 wherein said signal constellation is generated by one of a bi-phase shift keying (BPSK) code, a quadrature phase shift keying (QPSK) code, a 16-quadrature amplitude modulation (QAM) code, a 64-QAM code, and a 256-QAM code.

56. (Original) The receiver of Claim 47 wherein said receiver is implemented in a wireless metropolitan area network (WMAN).

57. (Previously Presented) The receiver of Claim 47 wherein said receiver is implemented in a wireless local area network (WLAN).

58. (Original) The receiver of Claim 47 wherein said in-phase and quadrature components comprise Gray coded data that is bit-interleaved.

59. (Original) The receiver of Claim 58 wherein said branch metric computing means implements bit-by-bit piecewise linear approximation to generate said branch metrics.

60. (Original) The receiver of Claim 59 further comprising deinterleaving means that communicates with said branch metric computing means for generating deinterleaved metrics based on said branch metrics.

61. (Previously Presented) A method for operating a space-time block decoder in a wireless communications system, comprising:

generating a demodulated symbol sequence by derotating a signal constellation of a received symbol sequence;

separating in-phase and quadrature components of said demodulated symbol sequence that are encoded based on a space time block code and an outer code; and

generating branch metrics based on said in-phase and quadrature components.

62. (Original) The method of Claim 61 further comprising generating user data based on said branch metrics.

63. (Original) The method of Claim 61 further comprising derotating said signal constellation by multiplying said received symbol sequence and a conjugate of a channel response of said wireless communications system.

64. (Original) The method of Claim 62 further comprising generating said user data by determining a minimum of a plurality of path metrics that comprise accumulations of said branch metrics.

65. (Original) The method of Claim 64 wherein said plurality of path metrics includes possible state transitions that identify a successive symbol in said received symbol sequence.

66. (Original) The method of Claim 61 wherein at least one symbol in said received symbol sequence is encoded with an orthogonal space-time code.

67. (Original) The method of Claim 61 wherein said signal constellation is generated by one of a bi-phase shift keying (BPSK) code, a quadrature phase shift keying (QPSK) code, a 16-quadrature amplitude modulation (QAM) code, a 64-QAM code, and a 256-QAM code.

68. (Original) The method of Claim 61 wherein said space-time block decoder is implemented in a wireless metropolitan area network (WMAN).

69. (Previously Presented) The method of Claim 61 wherein said space-time block decoder is implemented in a wireless local area network (WLAN).

70. (Original) The method of Claim 61 wherein said in-phase and quadrature components comprise Gray coded data that is bit-interleaved.

71. (Original) The method of Claim 70 further comprising implementing bit-by-bit piecewise linear approximation to generate said branch metrics.

72. (Original) The method of Claim 71 further comprising generating deinterleaved metrics based on said branch metrics.

73. (Previously Presented) A method of operating a receiver for a wireless communications system, comprising:

receiving a symbol sequence; and

generating user data based on said symbol sequence by generating branch metrics based on separated in-phase and quadrature components of a demodulated symbol sequence,

wherein said demodulated symbol sequence is based on said received symbol sequence, and

wherein said separated in-phase and quadrature components are encoded based on a space time block code and an outer code.

74. (Original) The method of Claim 73 further comprising generating said demodulated symbol sequence by derotating a signal constellation of said received symbol sequence.

75. (Original) The method of Claim 74 further comprising derotating said signal constellation by multiplying said received symbol sequence and a conjugate of a channel response of said wireless communications system.

76. (Original) The method of Claim 73 further comprising generating said user data based on said branch metrics.

77. (Original) The method of Claim 76 further comprising generating said user data by determining a minimum of a plurality of path metrics that comprise accumulations of said branch metrics.

78. (Original) The method of Claim 77 wherein said plurality of path metrics comprises possible state transitions that identify a successive symbol in said received symbol sequence.

79. (Original) The method of Claim 73 wherein at least one symbol in said symbol sequence is encoded with an orthogonal space-time code.

80. (Original) The method of Claim 74 wherein said signal constellation is generated by one of a bi-phase shift keying (BPSK) code, a quadrature phase shift keying (QPSK) code, a 16-quadrature amplitude modulation (QAM) code, a 64-QAM code, and a 256-QAM code.

81. (Original) The method of Claim 73 wherein said receiver is implemented in a wireless metropolitan area network (WMAN).

82. (Previously Presented) The method of Claim 73 wherein said receiver is implemented in a wireless local area network (WLAN).

83. (Original) The method of Claim 73 wherein said in-phase and quadrature components comprise Gray coded data that is bit-interleaved.

84. (Original) The method of Claim 83 further comprising implementing bit-by-bit piecewise linear approximation to generate said branch metrics.

85. (Original) The method of Claim 84 further comprising generating deinterleaved metrics based on said branch metrics.

86. (Previously Presented) The space-time block decoder of Claim 1 wherein said received symbol sequence is encoded based on a space-time block code in concatenation with an outer code.

87. (Previously Presented) The space-time block decoder of Claim 86 wherein said outer code generates a symbol sequence that is based off of user data that is mapped to constellation points of a signal constellation.

88. (Previously Presented) The space-time block decoder of Claim 86 wherein said space-time block code generates blocks of symbols based on a symbol sequence for transmission over multiple antennas.

89. (Previously Presented) The space-time block decoder of Claim 1 wherein said received symbol sequence is encoded based on a space-time block code that is transmitted over a plurality of antennas.

90. (Previously Presented) The space-time block decoder of Claim 1 wherein said branch metric computation module generates said branch metrics based on a one-dimensional relationship between said branch metrics and said demodulated symbol sequence and said in-phase and quadrature components.

91. (Previously Presented) The space-time block decoder of Claim 1 wherein said branch metric computation module generates said branch metrics for each dimension of said demodulated symbol sequence separately.

92. (Previously Presented) The space-time block decoder of Claim 1 wherein said branch metric computation module determines branch metrics based on expression $BM_{i,I} = -2z_{i,I}c_{i,I} + \left(|H|^2 \cdot c_{i,I}^2\right)$, where $z_{i,I}$ is a demodulated symbol, $c_{i,I}$ is a complex symbol, [[and]] H is a channel response, and i and I are integers.

93. (Previously Presented) The space-time block decoder of Claim 1 wherein said branch metric computation module determines branch metrics based on expression $BM_{i,I} = -z_{i,I} \cdot sign\left(c_{i,I}\right)$, where $z_{i,I}$ is a demodulated symbol, and $c_{i,I}$ is a complex symbol, and i and I are integers.

94. (Previously Presented) The space-time block decoder of Claim 1 wherein said branch metric computation module determines branch metrics based on at least one expression selected from $BM_{i,I} = -z_{i,I}$ and $BM_{I,I} = -z_{I,I}$, where $z_{I,I}$ is a demodulated symbol, and i and I are integers.

95. (Previously Presented) The space-time block decoder of Claim 17 wherein said space-time block decoder decodes a space-time block code that is concatenated with an outer code.

96. (Previously Presented) The space-time block decoder of Claim 1 wherein said branch metric computation module generates said branch metrics based on said in-phase and quadrature components for joint decoding of each of said in-phase and quadrature components.

IX. EVIDENCE APPENDIX

None

X. RELATED PROCEEDINGS APPENDIX

None